

**SENEGALIA BERLANDIERI, S. GREGGII AND S. WRIGHTII
HYBRIDS (FABACEAE: MIMOSOIDEAE) IN TEXAS AND
ADJACENT MEXICO**

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ABSTRACT

Principal component (PCA) and principal coordinate analyses (PCoA) suggest that *Senegalia x emoryana* is of hybrid origin, the probable parents being *S. berlandieri* and *S. greggii*. Many individuals and populations involving the parental species and F₁ hybrids, as well as backcrosses to either of the two parents, have been observed by the authors and others. This hybrid occasionally dominates disturbed habitats, becoming more common than the parental species. A hybrid morphologically similar to *S. x emoryana* involving *S. berlandieri* and *S. wrightii* is also discussed. The hybrid between *S. berlandieri* and *S. wrightii* (herein described as *Senegalia x turneri* Seigler & Ebinger), in contrast to *Senegalia x emoryana*, does not appear to be common; we have found relatively few individuals, mostly in association with the parents. *Phytologia* 94(3):439-455 (December 1, 2012).

KEY WORDS: *Senegalia*, hybrids, *Senegalia x emoryana*, *Senegalia x turneri*, *S. berlandieri*, *S. greggii*, *S. wrightii*

The genus *Senegalia* is a segregate of plants from *Acacia* s.l. with woody prickles scattered on the stem and commonly the leaf petiole and rachis, and flowers with a ring of glands at the base of the long-stalked ovary. The genus consists of 100 species in New World tropical and subtropical areas ranging from the southwestern United States south to Argentina and in the West Indies (Seigler et al. 2006). Nearly 100 additional species are found in the Old World tropics and subtropics of Asia, Africa, and Australia.

Only rarely have hybrids between New World species of *Senegalia* been reported (Britton and Rose 1928, Turner 1959, Correll and Johnston 1970, Johnson 1974). In our experience, all observed hybrids in this genus involve *S. berlandieri* (Benth.) Britt. & Rose as one of the parents and either *S. reniformis* (Benth.) Britt. & Rose, *S. crassifolia* (A. Gray) Britt. & Rose, *S. greggii* (A. Gray) Britt. & Rose or *S. wrightii* (Benth.) Britt. & Rose as the other parental species. These hybrids are restricted to the southwestern United States and northern Mexico (Maslin and Stirton 1997, Seigler et al. 2006) and are usually associated with disturbance, normally being found in pastures, edges of roads, and other disturbed sites. The present study was undertaken to examine the morphological differences of hybrids and hybrid populations involving *S. berlandieri* and the apparently related species *S. greggii* and *S. wrightii*. These three species are common components of thorn-scrub communities in large parts of the southwestern United States and adjacent Mexico.

MATERIALS AND METHODS

Three separate analyses were conducted, one involving *Senegalia berlandieri*, *S. greggii* and their suspected hybrids, the other involving *S. berlandieri*, *S. wrightii* and their suspected hybrids, and a third including all three species and their suspected hybrids. These analyses were based on herbarium specimens of the putative parents and hybrids from Texas and adjacent Mexico (Appendix I). Many of the specimens used were collected by the authors, but other materials were also included.

The study involving the *Senegalia berlandieri* x *S. greggii* population was undertaken using specimens collected by the authors at

the Chaparral Wildlife Management Area near Artesia Wells, Dimmitt and LaSalle Counties, Texas, in the northern half of the South Texas Plains ecological region (Correll and Johnston 1970). This management area is deer-proof fenced, about 6,150 ha in size, and utilizes a high intensity, low frequency rotational grazing system with stocking rates of one animal unit per 12 ha (Ruthven 2001). The study involving the *Senegalia berlandieri* x *S. wrightii* population was undertaken using specimens collected by the authors at the Harris Ranch, near Cline, 20 miles W of Uvalde, Uvalde County, Texas at the northern edge of the South Texas Plains ecological region. Managed by the Texas A & M University, Agricultural Research and Extension Center, Uvalde, the ranch is not deer-proof fenced, about 6,764 ha in size, and utilizes a cattle stocking rate of one animal unit to 35 ha (Cooper et al. 2008).

Initially, the specimens were separated into taxonomic groups based on overall morphological similarity and scored for 13 characters (Appendix II). These data served as the source of characters for principal component (PCA) and principal coordinate analyses (PCoA). Three or more measurements were made for each continuous character of each specimen. These values were then plotted to confirm that gaps in the data exist.

A few species of *Senegalia* have short shoots at many of the nodes on which clusters of leaves occur. Short shoot leaves, are usually smaller, have fewer pinna pairs, and smaller leaflets than the solitary or primary leaves found on the nodes of new growth. Primary leaves are larger, but rare or not present on many herbarium specimens. Of the species and hybrids studied in this paper, both *S. greggii* and *S. wrightii* have short shoots on which these smaller leaves are common. All measurements of *S. greggii* and *S. wrightii* used in these analyses were taken from short shoot leaves.

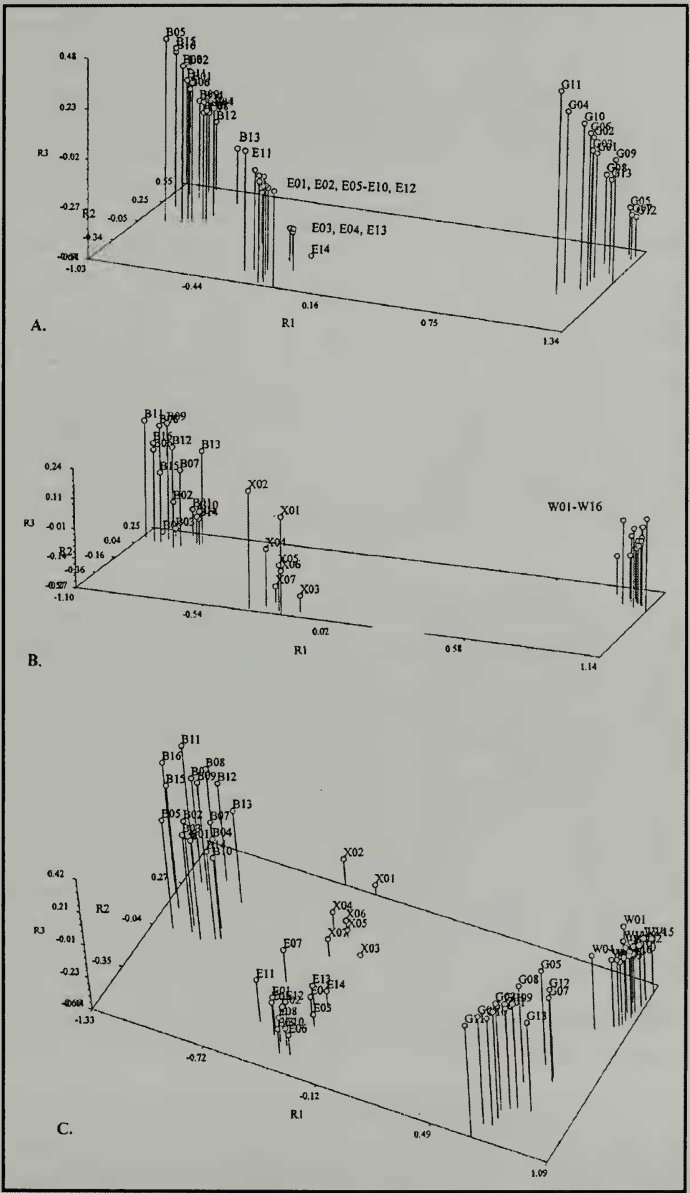
A PCA to identify groupings of the specimens examined was carried out. For this analysis, the data were first standardized and a correlation matrix, eigenvalues, and eigenvectors were calculated using NTSYS-pc version 2.1 (Rohlf 2000). Eigenvectors were scaled by the square root of λ . The axes were rotated and the resulting loading values graphically represented as both two- and three-dimensional plots.

To carry out PCoA analyses, Gower's resemblance coefficients were calculated (Legendre and Legendre 1983; Podani 1999; Dickinson 2000). The nature of each character was designated by binary, multistate, or quantitative descriptors and all characters were weighted equally (Dickinson 2000). The data matrix was transformed by the DCENTER algorithm using distances squared and eigenvectors and eigenvalues calculated with NTSYS-pc version 2.1 (Rohlf 2000). Eigenvectors were scaled by the square root of λ . The resulting loading values were graphically represented as both two- and three-dimensional plots.

Figure 1 (facing page). A. Three-dimensional plot for the principal component analysis using the 13 characters (Appendix II) of 16 specimens of *Senegalia berlandieri* (B01-B16), 13 specimens of *S. greggii* (G01-G13), and 14 specimens of probable hybrids (*S. x emoryana*) (E01-E14) from Chaparral Wildlife Management Area, Dimmitt and LaSalle Counties, Texas.

B. Three-dimensional plot for the principal component analysis using the 13 characters (Appendix II) of 16 specimens of *Senegalia berlandieri* (B01-B16), 16 specimens of *S. wrightii* (W01-W16), and 7 specimens of probable hybrids (*S. berlandieri* x *S. wrightii* = *S. x turneri*) from Harris Ranch, Uvalde County, Texas (X01-X07).

C. Three-dimensional plot for the principal component analysis using 13 characters (Appendix II) of 16 specimens of *Senegalia berlandieri* (B01-B16), 13 specimens of *S. greggii* (G01-G13), 16 specimens of *S. wrightii* (W01-W16), 14 specimens of *S. x emoryana* (E01-E14), and 7 specimens of *S. berlandieri* x *S. wrightii* (*S. x turneri*) (X01-X07) collected from throughout the range of *S. berlandieri* (Appendix I).



RESULTS

***Senegalia berlandieri* and *S. greggii*:** The analysis involved 16 specimens of *Senegalia berlandieri*, 13 specimens of *S. greggii* and 14 probable hybrids collected at Chaparral Wildlife Management Area. The PCA based on 13 characters (Appendix II), and a PCoA based on Gower's similarity coefficients proved to be similar (Figure 1A). In the PCA, the first three principal components accounted for 94% of the total variance. Leaflet pairs/pinna (Lep), pinna length (Pil), and petiole gland length (Gll) (characters 10, 7, and 3) were most important for determining the component score of the first axis; leaflet length (Lel), leaflet shape (Les), and gland shape (Gls) (characters 13, 11, and 4) were most important for determining the second axis. The specimens used in this analysis represented distinct groupings in both PCA and PCoA. The clusters for each of the parental species were well separated from each other and the cluster corresponding to hybrids was spatially located between the putative parental species (Figure 1A).

***Senegalia berlandieri* and *S. wrightii*:** The analysis involved 16 specimens of *Senegalia berlandieri*, 16 specimens of *S. wrightii* and 7 probable hybrids (*S. berlandieri* x *S. wrightii*) collected at Harris Ranch. The PCA based on all 13 characters (Appendix II) and a PCoA based on Gower's similarity coefficients for species scored proved to be similar (Figure 1B). In the PCA, the first three principal components accounted for 96% of the total variance. Leaflet distance (Led), pinna pair number (Pip), and rachis length (Ral) (characters 9, 6, and 5) were most important for determining the component score of the first axis; leaflet apex shape (Lea), leaflet shape (Les), and petiole gland shape (Gls) (characters 8, 11, and 4) were most important for determining the second axis. The specimens used in this analysis represented distinct groupings in both PCA and PCoA. The clusters for each of the parental species were well separated from each other and the cluster corresponding to hybrids was spatially located between the putative parental species (Figure 1B).

***Senegalia berlandieri*, *S. greggii*, and *S. wrightii*:** This analysis used herbarium specimens from throughout the range of these three species in south central and southern Texas and adjacent northern Mexico. The analysis involved 16 specimens of *Senegalia berlandieri*,

13 specimens of *S. greggii*, 16 specimens of *S. wrightii*, 14 specimens of *S. berlandieri* x *S. greggii* (*S. x emoryana*), and seven specimens of *S. berlandieri* x *S. wrightii* (Appendix I). No specimens of suspected backcrosses to either parent were included in the analysis. The PCA based on 13 characters (Appendix II), and a PCoA based on Gower's similarity coefficients for species scored proved to be similar (Figure 1C). In the PCA, the first three principal components accounted for 96% of the total variance. Short shoots (Shs), petiole gland shape (Gls), leaflet apex shape (Lea), and leaflet shape (Les) (characters 1, 4, 8, and 11) were most important for determining the component score of the first axis; leaflet length (Lel), leaflet distance (Led), and leaflet width (Lew) (characters 13, 9, and 12) were most important for determining the second axis. The specimens used in this analysis represented distinct groupings in both PCA and PCoA. The clusters for each of the parental species were well separated from each other and the clusters corresponding to hybrids were spatially located between the respective putative parental species (Figure 1C).

DISCUSSION

Senegalia berlandieri and *S. greggii*: Of these two taxa, *Senegalia greggii* has the most extensive distribution, known from southern California east through extreme southern Nevada and Utah, most of Arizona and New Mexico, through southern Texas, and south into Mexico in the states of Baja California Sur, Sonora, Chihuahua, Durango, Coahuila, Nuevo León and Tamaulipas. *Senegalia berlandieri*, in contrast, has a more restricted distribution in the United States, occurring in south central and southern Texas, and farther south than *S. greggii* in the states of Chihuahua, Durango, Zacatecas, Coahuila, Nuevo León, San Luis Potosí, Hidalgo, Guanajuato, Querétaro, and Tamaulipas, Mexico. The hybrid, *S. x emoryana*, is restricted to areas in which the parental species have an overlapping distribution, mostly in south central and southern Texas, and the states of Chihuahua, Coahuila, Durango, and San Luis Potosí, Mexico.

Senegalia x emoryana can easily be separated from both *S. berlandieri* and *S. greggii* using many of the characteristics listed in Appendix II. The most obvious and commonly used characteristics include: short shoot at most nodes of *S. greggii*, but are absent on *S. x*

emoryana and *S. berlandieri*; most leaves with 1-3 pinna pairs in *S. greggii*, 4-8 in *S. x emoryana*, and 9-15 on *S. berlandieri*; and many leaflets obovate to oblanceolate in *S. greggii*, and most leaflets linear to oblong in *S. berlandieri* and *S. x emoryana*. In floral material the globose inflorescence of *S. berlandieri* separates this species from *S. x emoryana* which has an elongated inflorescence that is less than twice as long as wide, and *S. greggii* which has an elongated inflorescence more than twice as long as wide. Backcrossed individuals are more difficult to identify, but these were only rarely encountered. The most common backcrossed specimens observed were between *S. berlandieri* x *S. x emoryana*. Separation was usually easy because *S. berlandieri* average 25 to 55 leaflets/pinna, whereas *S. x emoryana* averages 15 to 20 leaflets/pinna.

***Senegalia berlandieri* and *S. wrightii*:** Of these two taxa, *Senegalia wrightii* has a more extensive distribution in the United States than *S. berlandieri*, being known from southern Nevada and Arizona, and east through most of southern Texas (Little 1979). In Mexico, we have found specimens of *S. wrightii* from Baja California Sur, east through Chihuahua, Coahuila, Nuevo León, and Tamaulipas. It may occur further south into central Mexico but we have been unable to locate specimens. We have few specimens of the hybrid between these two taxa (*Senegalia berlandieri* and *S. wrightii*). In order to distinguish this hybrid from other taxa in the group it is important to select mature vegetative material; in particular, flowering material with immature leaflets often falls below 5.5 mm in length. In the original analysis, all of the proposed hybrid specimens were from the population at Harris Ranch near Cline, Texas. Presently, we have located additional specimens of this proposed hybrid, all from the South Texas Plains ecological region in southern Texas (Correll and Johnston 1970). Based on these specimens the proposed new hybrid is described. This hybrid is named after Dr. Billie L. Turner (Director Emeritus, University of Texas Herbarium) who has studied the *S. berlandieri*, *S. greggii*, *S. x emoryana* species complex and has annotated many specimens of this species complex at TEX (Turner 1959).

Senegalia x turneri Seigler, Ebinger, & Glass *nothomorph nov.*

Figure 2

TYPE: UNITED STATES. TEXAS: Uvalde Co.: Harris Ranch near Cline, 20 miles W of Uvalde on Rt. 90, 29°N 14' 38"; 100°W 06' 02", 18 Aug 2003, D. S. Seigler & J. E. Ebinger 15815 (Holotype: ILL). Putative hybrid between *Senegalia berlandieri* and *Senegalia wrightii*.

Shrub or small **tree** to 5 m tall. Bark light to dark brown, shallowly furrowed. Twigs dark grayish brown, straight, usually puberulent. Short shoots mostly absent. Prickles brown below, apex dark brown, flattened, usually slightly recurved, woody, 1-5 x 1-5 mm at the base, usually glabrous, persistent, scattered along the twig, sometimes rare to absent. **Leaves** alternate, 25-70 mm long. Stipules light to dark brown, narrowly triangular to linear, symmetrical, flattened, straight, herbaceous, 0.5-2.1 x 0.3-1.1 mm near the base, puberulent, tardily deciduous. Petiole adaxially grooved, 5-20 mm long, puberulent; petiolar gland solitary, located on the upper half of the petiole, sessile in the expanded petiole groove with the margins raised, orbicular to elliptic, 0.8-2.1 long, apex depressed, glabrous. Rachis adaxially grooved, 15-45 mm long, puberulent, an oval to orbicular gland 0.4-1.2 mm long between the upper pinna pair, apex depressed, glabrous. Pinnae 2 to 7 pairs per leaf, 20-45 mm long, 4-14 mm between pinna pairs; paraphyllidia 0.2-0.5 mm long; petiolule 1.1-3.1 mm long. Leaflets 13 to 21 pairs per pinna, opposite, 0.6-2.1 mm between leaflets, oblong, 5.1-9.3 x 0.7-2.6 mm, glabrous to lightly appressed puberulent on both surfaces, lateral veins obvious, 1 to 4 veins from the base, base oblique and obtuse, margins ciliate, apex acute, midvein submarginal. **Inflorescence** a densely 35- to 85-flowered subglobose head, slightly longer than wide, 8-13 mm wide, usually solitary in the leaf axil. Peduncles 7-25 x 0.5-0.8 mm wide, puberulent; receptacle elongated, slightly enlarged. Involucre a single small bract on the upper half of the peduncle, early deciduous. Floral bracts linear to spatulate, 0.9-1.7 mm long, puberulent, early deciduous. **Flowers** sessile, white; calyx 5-lobed, 1-2 mm long, puberulent; corolla 5-lobed, 2-3 mm long, puberulent, lobes one-quarter the length of the corolla; stamen filaments 5-7 mm long, distinct; anther glands absent; ovary lightly pubescent, stipe to 0.6 mm long. **Legumes** light to dark

brown, straight to slightly curved, flattened, usually constricted between some seeds, oblong, 40-160 x 20-35 mm, coriaceous, lightly transversely striated, puberulent, eglandular, dehiscent along both sutures; stipe 5-20 mm long; apex obtuse, short beaked to lacking a beak. **Seeds** uniseriate, no pulp, brown, orbicular, flattened, 8-12 x 5-8 mm, smooth; pleurogram U-shaped, 1-3 mm across.

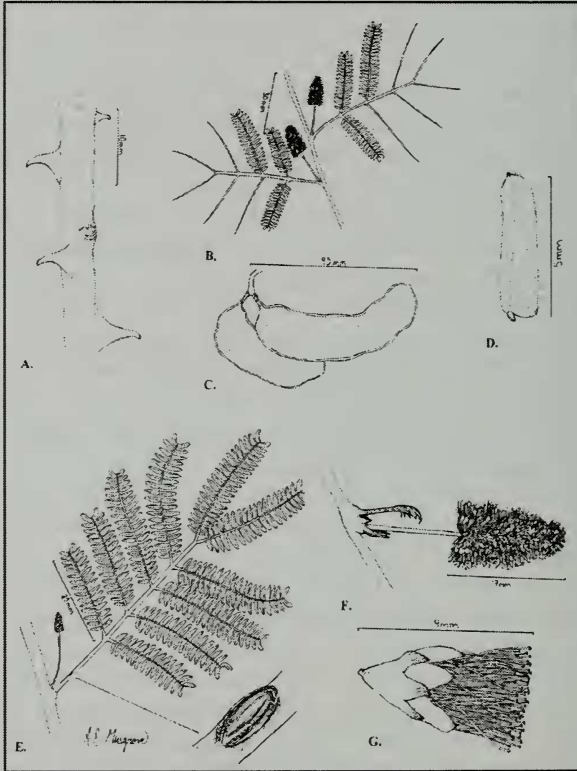


Figure 2 *Senegalia x turneri* Seigler, Ebinger & Glass. A: Twig with prickles (*E. J. Palmer 12330*). B: Habit sketch with inflorescences (*Seigler & Ebinger 15815*). C: Fruits (*Seigler & Ebinger 15815*). D: Leaflet (adaxial surface) (*Seigler & Ebinger 15799*). E: Leaf with petiolar gland (*Seigler & Ebinger 15799, 15808*). F: Inflorescence (*Seigler & Ebinger 15799, 15815*). G: Flower (*Seigler & Ebinger 15799, 15815*).

Flowers: April-June.

Distribution: Limestone outcrops in gravelly, calcareous, and disturbed soils between sea level and 1700 m in southern Texas.

Specimens examined: UNITED STATES: Texas: **Hidalgo Co.:** Armando Vela property, 85 ft., 11 Nov 2003, *W.R.Carr & A.Vela* 22700 (ILL, TEX). **Kinney Co.:** Kickapoo State Park, 6 Aug 1988, *T.Keeney* 8620 (BRIT); 9 miles NE of Bracketville, 9 Jun 1955, *B.L.Turner* 3879 (TEX). **Live Oak Co.:** 7 miles S of George West, 6 Apr 1953, *M.C.Johnston s.n.* (TEX); **Maverick Co.:** Eagle Pass, *V.Havard* 1375 (MO). **Uvalde Co.:** Roadside, 2 miles S of Garner Park, 29 Apr 1973, *T.Keeney* 833 (SMU); Vacant lot, Knippa, 13 Sep 1988, *T.Keeney* 8613 (BRIT); Along Frio River, W of Knippa at the Dude Ranch off Cactus Flats Road, 12 Aug 1994, *T.Keeney* 10410 (BRIT); Uvalde, 20 Jun 1917, *E. J. Palmer* 12318 (MINN); Montell, 23 Jun 1917, *E. J. Palmer* 12330 (MO). Winston Ranch, 4 miles S of Sabinal, Rt. 187, 10 May 2003, *M.Reed, H.Loring, E.Winston M, H.Wilson, T.Wilson & R.Corbett* 2633 (BRIT); Harris Ranch near Cline on Rt. 90, 24 Jun 2002, *D.S.Seigler & J.E.Ebinger* 15217 (ILL); Harris Ranch near Cline on Rt. 90, 18 Aug 2003, *D.S.Seigler & J.E.Ebinger* 15797 (ILL); Harris Ranch near Cline on Rt. 90, 18 Aug 2003, *D.S.Seigler & J.E.Ebinger* 15798 (ILL, MU); Harris Ranch near Cline on Rt. 90, 18 Aug 2003, *D.S.Seigler & J.E.Ebinger* 15799 (ILL, NY, TEX); Harris Ranch near Cline on Rt. 90, 18 Aug 2003, *D.S.Seigler & J.E.Ebinger* 15808 (ILL); Harris Ranch near Cline on Rt. 90, 18 Aug 2003, *D.S.Seigler & J.E.Ebinger* 15809 (ILL); Harris Ranch near Cline on Rt. 90, 18 Aug 2003, *D.S.Seigler & J.E.Ebinger* 15815 (ILL); Harris Ranch near Cline on Rt. 90, 18 Aug 2003, *D.S.Seigler & J.E.Ebinger* 15819 (ILL); Harris Ranch near Cline on Rt. 90, 18 Aug 2003, *D.S.Seigler & J.E.Ebinger* 15821 (ILL); Harris Ranch near Cline on Rt. 90, 18 Aug 2003, *D.S.Seigler & J.E.Ebinger* 15822 (ILL); Harris Ranch near Cline on Rt. 90, 18 Aug 2003, *D.S.Seigler & J.E.Ebinger* 15829 (ILL); Harris Ranch near Cline on Rt. 90, 18 Aug 2003, *D.S.Seigler & J.E.Ebinger* 15833 (ILL); Harris Ranch near Cline on Rt. 90, 18 Aug 2003, *D.S.Seigler & J.E.Ebinger* 15838 (ILL). **Val Verde Co.:** Devil's River, 5 miles above Ft. Hudson, 3 May 1949, *W.V.Brown s.n.* (TEX); Rocky banks of Devils River, 26 Mar 1917, *E.J.Palmer* 11379 (MINN); 4.2 miles N of US 90, N of Del Rio, on US 277-377,

1200 ft., 27 Mar 1986, T.R. Van Devender & R.K. Van Devender 86-80 (ASU).

Key to the species and hybrids examined:

1. Short shoots present at many nodes, these with clusters of leaves; inflorescence a spike more than twice as long as wide.
 2. Most leaflets less than 5.5 mm long (2.8-5.5 by 0.9-3.2 mm); flower stalks 0- 0.6 mm long.....*Senegalia greggii*
 2. Most leaflets more than 5.5 mm long (5.5-9.2 by 2.2-4.5 mm); flower stalks mostly more than 0.7 mm long....*Senegalia wrightii*
1. Short shoots mostly absent; inflorescence globose or a short spike less than twice as long as wide.
 3. Most leaves with 9-15 pinna pairs; most pinnae with 30-55 pairs of leaflets; inflorescence globose.....*Senegalia berlandieri*
 3. Most leaves with fewer than 9 pinna pairs; most pinnae with 2-25 pairs of leaflets; inflorescence a short spike less than twice as long as wide.
 4. Most fully expanded mature leaflets more than 5.5 mm long (5.1-9.3 mm by 0.7-2.6 mm).....*Senegalia x turneri*
 4. Most fully expanded mature leaflets less than 5.4 mm long (3-6 by 0.7-1.7 mm).....*Senegalia x emoryana*

ACKNOWLEDGEMENTS

The authors wish to thank several colleagues for advice concerning questions of nomenclature and general taxonomic advice, in particular, K. N. Gandhi, as well as two reviewers Drs. Michael Vincent and Tom Zanoni, and Donald Ruthven of the Chaparral Wildlife Management Area for assistance in the field. We greatly appreciate the assistance of Curators who loaned specimens for this study. We wish to acknowledge support by the National Science Foundation (NSF DEB 04-15803), the International Arid Lands Consortium (OIR005, 2001-2004), and by the American Philosophical Society (1992). We also wish to thank the artist Alexa Musgrove for preparing the drawings of this species.

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Appendix I. Specimens examined and scored for the 13 characters used in this study.

Senegalia berlandieri: MEXICO: Coahuila: S of Monclova on Rt. 57, 30 May 1983, *D.S.Seigler, J.Kramer & E.Carreira 12034* (ILL); S of Monclova on Rt. 57, 30 May 1983, *D.S.Seigler, J.Kramer & E.Carreira 12040* (ILL). San Luis Potosí: 14 miles W of Río Verde, Rt. 70, 3 Jun 1991, *D.S.Seigler, J.E.Ebinger, H. D. Clarke & K.Readel 13705* (ILL). UNITED STATES: Texas: Dimmit Co.: Chaparral Wildlife Management Area, 19 May 2005, *D.S.Seigler, J.Miller & B.R.Maslin 15937* (ILL). Duval Co.: 6 miles S of Freer on Rt. 16, 20 May 1983, *D.S.Seigler, J.Kramer & E.Carreira 11937* (ILL). Jim Wells Co.: 9 miles N of Alice on US Rt. 281, 6 Jun 1991, *D.S.Seigler, J.E.Ebinger, H.Clarke & K.Readel 13765c* (ILL). Kinney Co.: 10 miles E of Brackettville on Ranch Road 334, 20 May 1976, *D.S.Seigler, S.Saupe, & H.Welt 9942* (ILL). La Salle Co.: Chaparral Wildlife Management Area, 25 May 2003, *D.S.Seigler & J.E.Ebinger 15676* (ILL). McMullen Co.: S edge of Tilden, Rt. 16, 10 Jul 1998, *D.S.Seigler & J.E.Ebinger 14337* (ILL); 3 miles E and 1 mile N of Tilden, 25 May 2001, *D.S.Seigler & J.E.Ebinger 15027* (ILL). Medina Co.: 2 miles W of D'Hanis, 4 Mar 1954, *O.E.Sperry 2975* (ILL). Starr Co.: access road to Falcon Dam, 18 Feb 2004, *D.S.Seigler, J.E.Ebinger & L.R.Phillippe 15896* (ILL). Uvalde Co.: Harris Ranch near Cline, 24 Jun 2002, *D.S.Seigler & J.E.Ebinger 15250* (ILL). Val Verde Co.: 16 miles W of Comstock, Rt. 90, 10 Jul 1998, *D.S.Seigler & J.E.Ebinger 14350* (ILL); Langtry, 21 May 1976, *D.S.Seigler, S.Saupe & H.Welt 9952* (EIU, ILL). Webb Co.: 5 miles NE of Laredo on US 59, 15 Sep 1979, *D.S.Seigler & D.A.Young 11369* (ILL).

Senegalia greggii: MEXICO: Nuevo León: Dirt road W of Canon Ojo De Agua near Bustamante, 17 May 1997, *C.Glass & G.Glass 359* (ILL). Near Grutas de García, NW of Monterrey, 800 m, 14 May 1991, *D.S.Seigler, J.Ebinger, H.Clarke & K.Readel 13366* (ILL). UNITED STATES: Texas: Atascosa Co.: Road to San Miguel Power Plant, 10 Jul 1998, *D.S.Seigler & J.E.Ebinger 14324* (ILL). Brewster Co.: Roadside, 15 miles S of Marathon, 18 May 1990, *J.E.Ebinger 24679* (EIU); Rio Grande Village, 11 Jul 1998, *D.S.Seigler & J.E.Ebinger 14394* (ILL). Crockett Co.: 2 miles S of Interstate 10, W of Ozona, 12 Jul 1998, *D.S.Seigler & J.E.Ebinger 14409* (ILL). Dimmitt Co.: Chaparral Wildlife Management Area, 19 May 2005, *D.S.Seigler,*

J. Miller & B.R. Maslin 15938 (ILL). **Jim Wells Co.:** 9 miles N of Alice on US 281, 6 Jun 1991, *D.S. Seigler, J. Ebinger, H. Clarke & K. Readell 13765v* (ILL). **La Salle Co.:** Chaparral Wildlife Management Area, 23 May 2003, *D.S. Seigler & J.E. Ebinger 15667* (ILL). **McMullen Co.:** S of Tilden on Rt. 16, 11 May 1991, *D.S. Seigler, J. Ebinger, H. Clarke & K. Readell 13264* (ILL); 3 km. N of Tilden on Rt. 16, 20 May 1983, *D.S. Seigler, J. Kramer & E. Carreira 11935* (ILL). **Pecos Co.:** 7 miles E of Bakersfield, 22 May 1977, *D.S. Seigler & S.G. Saupe 10449* (ILL). **Terrell Co.:** 20 miles E of Sanderson, Rt. 90, 10 Jul 1998, *D.S. Seigler & J.E. Ebinger 14360* (ILL).

Senegalia wrightii: MEXICO: **Coahuila:** Rt. 57, between Allende and Nueva Rosita, 480 m, 5 Jun 1997, *C. Glass & G. Glass 439* (ILL). **Nuevo León:** Near Grutas de García, 800 m, 14 May 1991, *D.S. Seigler, J. Ebinger, H. Clarke & K. Readell 13359* (ILL); 10 miles N of Montemorelos on hwy. 85, 6 Jul 1983, *D.S. Seigler, J. Kramer & E. Carreira 12124* (ILL). **Tamaulipas:** 5 miles E of Lucio Blanco, near Linares, 305 m, 20 May 1997, *C. Glass & G. Glass 368* (ILL); Rt. 85, S of Linares, 640 m, 20 May 1997, *C. Glass & G. Glass 369* (ILL). UNITED STATES: **Texas:** **Callahan Co.:** 10 miles S of Baird, Rt. 283, 13 Jul 1998, *D.S. Seigler & J.E. Ebinger 14426* (ILL). **La Salle Co.:** Farm Road 624, E of Cotulla, 19 May 2005, *D.S. Seigler, J.T. Miller & B.R. Maslin 15939* (ILL). **Maverick Co.:** 10 miles E of Eagle Pass, 27 Jun 2002, *D.S. Seigler & J.E. Ebinger 15269* (ILL). **Schleicher Co.:** 7 miles SW of Fort McKavett, Rt. 864, 13 Jul 1998, *D.S. Seigler & J.E. Ebinger 14411* (ILL). **Shackelford Co.:** 16 miles S of Albany and 2 miles N of county line, Rt. 283, 13 Jul 1998, *D.S. Seigler & J.E. Ebinger 14425* (ILL). **Starr Co.:** 6 miles NW of Roma-Los Saens, Rt. 83, 20 May 1983, *D.S. Seigler, J. Kramer & E. Carreira 11953* (ILL). **Uvalde Co.:** Harris Ranch, near Cline, 20 miles W of Uvalde, 24 Jun 2002, *D.S. Seigler & J.E. Ebinger 15219* (ILL); 1 mile W of Blanco River, rest area on Rt. 90, E of Uvalde, 27 Jun 2002, *D.S. Seigler & J.E. Ebinger 15271* (ILL); 15 miles NW of Uvalde, off hwy 55, 27 May 2002, *D.S. Seigler & J.E. Ebinger 15688* (ILL). **Zapata Co.:** Arroyo Dolores where it is crossed by US 83, 25 miles N of Zapata, 18 Feb 2004, *D.S. Seigler, J.E. Ebinger & L.R. Phillippe 15883* (ILL). **Zavala Co.:** 6 miles N of La Pryor, US 83, 27 May 2003, *D.S. Seigler & J.E. Ebinger 15686* (ILL).

Senegalia x emoryana (Senegalia berlandieri x S. greggii):**MEXICO: Chihuahua:** 21 km. NW of Escalón, 1650 m, 7 Jul 1972,*F.Chiang, T.L.Wendt & M.C.Johnston 8308 (LL).* **Coahuila:** 5 km. E

of San José del Refugio on road to Santa Teresa, 1675 m, 5 Jul 1972,

F.Chiang, T.L.Wendt & M.C.Johnston 8266 (MEXU); Virgen deGuadalupe shrine, 3100 ft., 7 Aug 1973, *J.Henrickson 12036 (LL);*Cañón de Fora, 1100 m, 7 May 1973, *M.C.Johnston, T.L.Wendt &**F.Chiang C. 10908 (NY).* **Durango:** 42 miles E of La Zarca, 21 Apr1960, *J.Crutchfield & M.C.Johnston 5284 (MEX).* **UNITED STATES:****Texas: Brewster Co.:** SW end of Bullis Canyon of Rio Grande, 500-600 m, 8 Apr 1973, *M.C.Johnston, T.L.Wendt & F.Chiang C. 10592*(LL); Anderson's ranch, Marathon, 26 Jun 1929, *H.B.Parks, Jr. 4031*(F). **Dimmitt Co.:** Chaparral Wildlife Management Area, 19 May2005, *D.S.Seigler, J.Miller & B.R.Maslin 15933 (ILL).* **Jim Wells Co.:**9 miles N of Alice, Rt. 281, 6 Jun 1991, *D.S.Seigler, J.E.Ebinger,**H.Clarke & K.Readel 13769 (ILL).* **McMullen Co.:** N of Tilden, hwy.16, 20 Jul 2004, *D.S.Seigler & B.Maslin 12667 (ILL);* 33 miles N ofFreer, 22 May 1976, *D.S.Seigler, S.Saupe & H.Welt 10040 (ILL).***Presidio Co.:** 1 mile W of San Antonio Canyon, 3800 ft., 13 Jun 1977,*M.Butterwick & E.Lott 3849 (TEX).* **Val Verde Co.:** 8 miles E ofLangtry, Rt. 90, 7 Jul 1958, *D.S.Corrrell & I.M.Johnston 19412 (LL);*10 miles NW of Langtry, 1 May 1955, *B.L.Turner 3767 (TEX).***Senegalia x turneri (Senegalia berlandieri x S. wrightii):** **UNITED****STATES: Texas: Hidalgo Co.:** Armando Vela property, 85 ft., 11 Nov2003, *W.R.Carr & A.Vela 22700 (ILL, TEX).* **Kinney Co.:** 9 miles NEof Bracketville, 9 Jun 1955, *B.L.Turner 3879 (TEX).* **Live Oak Co.:** 7miles S of George West, 6 Apr 1953, *M.C.Johnston s.n. (TEX).***Maverick Co.:** Eagle Pass, *V.Havard 1375 (MO).* **Uvalde Co.:**Uvalde, 20 Jun 1917, *E. J. Palmer 12318 (MINN);* Montell, 23 Jun1917, *E. J. Palmer 12330 (MO).* **Val Verde Co.:** Devil's River, 5 milesnorth Ft. Hudson, 3 May 1949, *W.V.Brown s.n. (TEX).*

Appendix II. Characters scored for the principal component (PCA) and principal coordinate analyses (PCoA) of the *Senegalia berlandieri*, *S. greggii*, and *S. wrightii* species complex.

1. **Short shoots (Shs)** 1 = absent or nearly so, 2 = common at stem nodes.
2. **Petiole length in mm (Pel).**
3. **Petiole gland length in mm (Gll).**
4. **Petiole gland shape (Gls)** 1 = elliptic, 2 = round or nearly so.
5. **Rachis length in mm (Ral).**
6. **Pinna pair number (Pip).**
7. **Pinna length in mm (Pil).**
8. **Leaflet apex shape (Lea)** 1 = acute, 2 = obtuse.
9. **Leaflet distance in mm (Led).**
10. **Leaflets pairs/pinna (Lep).**
11. **Leaflet shape (Les)** 1 = nearly all linear to oblong, 2 = many obovate to oblanceolate.
12. **Leaflet width in mm (Lew).**
13. **Leaflet length in mm (Lel).**